12. (Amended) The method of claim 3 wherein the target stem cells are hematopoietic stem cells.

A3

17. (Amended) A population of stem cells transduced with vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest, wherein the vector particles are substantially free of producer cells and producer cell supernatant and whereby the transduced stem cells are capable of expressing the gene of interest.

A4

REMARKS

Applicants have carefully studied the Office Action mailed on February 13, 2002, which issued in connection with the above-identified application. The present amendments and remarks are intended to be fully responsive to all points of rejection raised by the Examiner and are believed to place the claims in condition for allowance. Favorable reconsideration and allowance of the present claims are respectfully requested.

Pending Claims

Claims 1-37 were pending and at issue in the application. Claims 19-37 have been removed from the examination as being drawn to a non-elected invention. Applicants respectfully traverse the finality of the Restriction Requirement and request reconsideration of the Requirement to allow prosecution of all pending claims in the same application.

Thus, applicants respectfully note that claims 19 and 20 merely recite features of the cells of claim 18. In fact, in the Restriction Requirement mailed on December 5, 2001, these claims were grouped together with claims 17 and 18 in Group II. Furthermore, the limitations recited in claims 19 and 20 are also recited in claims 15 and 16. Accordingly, claims 19 and 20 should be considered with the elected claims. In the Office Action, claims 15 and 16 have been indicated as free of the prior art. Consequently, claims 19 and 20 are also free of the prior art.

As specified in the applicants' response to the Restriction Requirement mailed on December 5, 2001, claims 21-30 recite the use of the stem cells of claim 17 and therefore should be also considered with the elected claims.

In the Office Action, claims 1-18 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Claims 1, 2, 8, 12-14, 17, and 18 have been rejected under 35 U.S.C. § 102(b) as being anticipated by and claims 1-14, 17, and 18 have been rejected under 35 U.S.C. § 103(a) as being obvious over the prior art.

Claim 1 has been canceled. Claims 2, 4, 10, and 12 have been amended to correct their dependency. Claims 3 and 17 have been added to more particularly point out and distinctly claim the invention. Claim 3 as amended is independent and incorporates all the features of claim 1. Specific support for the new recitation "whereby the transduced stem cells are capable of expressing the gene of interest" in claims 3 and 17 can be found, for example, in the original claims 15-16, 19-20, and 24-25, page 11, lines 8-11, page 24, line 25 - page 25, line10, Example 1 (in particular, page 37, lines 26-28), and in Example 6 (page 45). This feature was implicit to the claims as filed, so this amendment does not narrow the claims. Specific support for the new

recitation "substantially free of producer cells and producer cell supernatant" in claim 17 can be found, for example, in the original claim 3, page 10, lines 21-29, page 15, lines 8-25, and at page 25, line 24 - page 26, line 6. No new subject matter has been added as a result of the amendments; no new search is required, and no new issues are raised. Following entry of these amendments, claims 2-37 will be pending.

35 U.S.C. § 112, Second Paragraph, Rejections

In the Action, claims 1-18 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Specifically, the Examiner states that the term "highly efficient" in claims 1-18 is a relative term which renders these claims indefinite. The pending set of claims do not recite this term, thus obviating the rejection.

In the Office Action, claims 1-18 also stand rejected as allegedly indefinite for reciting the term "substantially". The Examiner contends that it is not clear (i) to what extent the vector particles need to be free of factors, producer cells and producer cell supernatant and (ii) what percentage of cells need to be undifferentiated. Applicants respectfully disagree and note that, at page 15, lines 8-25, the present specification provides a very detailed and specific definition (with examples of numeric values) of the terms "substantially free of factors that induce stem cell differentiation" and "substantially free of producer cells and producer cell supernatant".

The Examiner further states that claims 1-16 are incomplete for omitting the essential step of expressing the gene of interest in transduced stem cells. Applicants respectfully traverse the rejection and note that claims 1-16 are directed to a method for transducing stem cells with a vector particle containing a gene of interest. According to a dictionary definition (attached as Exhibit A), the term "transduction" refers to a process of gene transfer and not to gene expression. In fact, gene expression may or may not follow the transduction. Applicants further note that, in contrast to the Examiner's assertion, claims 1-16 are complete as they recite the only step essential for transduction, *i.e.*, contacting target cells with vector particles. Certainly, however, such cells are capable of expressing the gene of interest, and the claims have been amended accordingly.

In light of the foregoing, applicants respectfully submit that the rejection of the claims based upon 35 U.S.C. §112, second paragraph, is overcome and withdrawal of such is kindly requested.

35 U.S.C. § 102(b) Rejection

In the Action, claims 1, 2, 8, 12-14, 17, and 18 stand rejected as being anticipated by Porter *et al.* (Hum. Gene Ther., 1996, 7:913-919). The Examiner contends that Porter *et al.* teach stem cell transduction with retroviral vector particles pseudotyped with RD114. In response, applicants respectfully submit that, as claim 1 has been canceled, the rejection of this claim is rendered moot. With respect to the remaining claims as amended, applicants respectfully note that these claims call for a method for transducing stem cells with vector

particles (and the resulting transduced stem cells), wherein the vector particles are substantially free of factors that induce stem cell differentiation by being substantially free of producer cells and producer cell supernatant. Porter *et al.* do not disclose or suggest that the vector particles should be substantially free of factors that induce stem cell differentiation, *e.g.*, by being substantially free of both producer cells and producer cell supernatant. In fact, they teach away from the present invention by disclosing, *e.g.*, at page 915 (left column, ¶3 and right column, ¶ 2) and page 917 (Table 3), that, to maximize the efficiency of infection, the transduction of pseudotyped vectors into bone marrow cells was performed by co-cultivation with virus-producing cells. The present invention establishes that such co-culturing is neither necessary nor desirable.

In light of the foregoing amendments and remarks, it is respectfully submitted that pending claims are not anticipated by Porter *et al.* Reconsideration and withdrawal of the anticipation rejection is believed to be in order.

35 U.S.C. § 103(a) Rejections

In the Office Action, claims 1-6, 8, 10-14, 17, and 18 stand rejected as being obvious over Porter *et al.* (Hum. Gene Ther., 1996, 7:913-919) in view of Moritz *et al.* (Blood, 1996, 3:855-862). The Examiner contends that Porter *et al.* teach stem cell transduction with retroviral vector particles pseudotyped with RD114. The Examiner further contends that Moritz *et al.* reference teaches that binding to fibronectin improves the transduction efficiency of the retroviral vectors. The Examiner concludes that the skilled artisan would have been motivated to

combine the teachings of Porter *et al.* and Moritz *et al.* to develop a method to improve the transduction efficiency of hematopoietic stem cells.

Claims 1-3, 7-14, 17, and 18 stand further rejected as being obvious over Porter *et al.* (Hum. Gene Ther., 1996, 7:913-919) in view of Uchida *et al.* (Proc. Natl. Acad. Sci. USA, 1998, 95:11939-11944). The Examiner contends that Uchida *et al.* reference allegedly describes (i) the use of a lentiviral vector for highly efficient gene transfer into hematopoietic stem cells; (ii) that the viral stocks were concentrated by ultracentrifugation, thus removing producer cells and supernatants, and (iii) that pre-stimulation with cytokines would stimulate hematopoietic stem cells into cell cycle before transduction. The Examiner concludes that the skilled artisan would have been motivated to combine the teachings of Porter *et al.* and Uchida *et al.* to develop a method to improve a transduction efficiency of hematopoietic stem cells using a lentiviral vector pseudotyped with RD114 envelope and pre-stimulating cells with cytokines, as recited in the instant claims.

As claim 1 has been canceled, the rejections of this claim are rendered moot.

With respect to the remaining claims as amended, applicants respectfully traverse the rejection and submit that, even if taken together, the cited references do not disclose or suggest the methods and products of the present invention.

Applicants note that, determination that the invention is obvious requires that (i) cited references teach the claimed invention as a whole, and (ii) both the suggestion of making the present invention, and a reasonable expectation of success can be found in the prior art, not in the applicants' disclosure. MPEP Section 2143; *In re Dow Chemical Co.*, 5 U.S.P.Q.2d 1529,

1531 (Fed. Cir. 1988); *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Applicants respectfully submit that neither of these criteria has been met. Neither of the two secondary references provides a suggestion to be combined with Porter *et al.* reference or to modify the disclosed method of stem cell transduction, so that it becomes in any way analogous to the method recited in the present claims.

The instant claims call for a method for transducing stem cells with vector particles (and the resulting transduced stem cells), wherein the vector particles are (i) pseudotyped with feline endogenous virus RD114 envelope protein and (ii) are substantially free of factors that induce stem cell differentiation, *e.g.*, by being substantially free of both producer cells and producer cell supernatant. Applicants respectfully note that Moritz *et al.* do not disclose or suggest the use of RD114 protein to pseudotype the retroviral particles. Also, as specified above, Porter *et al.* do not disclose or suggest that the vector particles should be substantially free of factors that induce stem cell differentiation, *e.g.*, by being substantially free of both producer cells and producer cell supernatant. Porter *et al.* report, *e.g.*, at page 915 (left column, ¶3 and right column, ¶ 2) and page 917 (Table 3), that, to maximize the efficiency of infection, the transduction of pseudotyped vectors into bone marrow cells was performed by co-cultivation with virus-producing cells. It is important to note that, until the present invention, this was the only way known to transduce an RD114-pseudotyped virus.

Applicants further note that, as specified in the present disclosure and recited in the instant claims, one way to provide the vector particles, which are substantially free of factors that induce stem cell differentiation, is to pre-adsorb them onto an adherent surface coated with

an adherence promoting agent such as retronectin, fibronectin, or polylysine (*see, e.g.*, page 26, line 31 - page 27, line 4). As disclosed in the present specification and recited in claim 6, the preferred adherence promoting agent of the invention is retronectin.

Moritz *et al.* describe that binding to fibronectin improves the efficiency with which N_2/ZipT-KNEO retroviral vectors transduce murine hematopoietic stem cells. There is no indication in Moritz *et al.* that the approach disclosed there would work in any other system. In fact, in contrast to the present invention, Moritz *et al.* concede that "infection of human HSC appears inefficient" (*see* page 860, left column, ¶2) and fail to disclose or suggest the use of alternative adherence promoting agents, much less infecting human HSCs. Moreover, in the case of stem cell transduction, this reference teaches away from using any adherence promoting agent other than the FN 30/35 fragment of fibronectin (FN) by stating at page 860 (left column, ¶2) that "this study did demonstrate the need for adhesion of target cells specifically to FN 30/35 versus other cell binding domains in FN for efficient transduction of more primitive populations" (emphasis added). Such teaching away is a strong evidence of non-obviousness. *In re Bell*, 26 U.S.P.Q.2d 1529 (Fed. Cir. 1993). It certainly precludes any reasonable expectation of success.

In summary, neither Porter *et al.* nor Moritz *et al.* provide a reasonable expectation of success or a suggestion to be combined with the other reference to disclose or suggest the transduction method and the resulting transduced stem cells as recited in the present claims.

In relation to Uchida *et al.*, applicants respectfully note that the Examiner has misunderstood the method of the present invention and Uchida *et al.* reference with respect to

lentiviral vectors. As follows from the Office Action, the Examiner believes that the use of lentiviral vectors to improve the transduction efficiency involves a pre-stimulation of target cells with cytokines. Applicants respectfully disagree and note that, in contrast to the Examiner's assertion, the main benefit of the use of lentiviral vectors is their ability to transduce non-dividing (*i.e.*, non-stimulated) cells (*see, e.g.*, page 4, lines 1-12 and Examples 1 and 5 of the present specification and Abstract, page 11939 [right column, ¶2], and page 11940 [right column, ¶2] of Uchida *et al.* article). Accordingly, by disclosing superior transduction efficiency of the lentiviral vectors, Uchida *et al.* teach away from pre-stimulating target cells as recited in the present claim 10.

Applicants also note, that, in contrast to the Examiner's assertion, Uchida *et al.* reference teaches at page 11940, column 2, lines 11-14 that, prior to transduction, the viral stocks were concentrated by ultrafiltration and not by ultracentrifugation as recited in the present claims.

In response to the rejection, applicants respectfully submit that neither Porter *et al.* nor Uchida *et al.* provide a suggestion to be combined with the other reference or to modify the disclosed method of stem cell transduction, so that it becomes in any way analogous to the method recited in the present claims.

The instant claims call for a method for transducing stem cells with vector particles (and the resulting transduced stem cells), wherein the vector particles are (i) pseudotyped with feline endogenous virus RD114 envelope protein and (ii) are substantially free of factors that induce stem cell differentiation by being substantially free of producer cells and

producer cell supernatant. As acknowledged by the Examiner at page 6 of the Office Action (¶2), Porter *et al.* do not teach or suggest the use of lentiviral vectors for transduction and pre-stimulation of hematopoietic stem cells with cytokines. Applicants also note that Uchida *et al.* do not disclose or suggest the use of RD114 protein to pseudotype the lentiviral particles. In fact, this article teaches away from the use of RD114-pseudotyped particles disclosed by Porter *et al.* by describing a preferred stem cell transduction properties of VSV-G pseudotyped lentiviral particles. As specified in Example 5 of the instant application, the present inventors were the first to create the RD114-pseudotyped lentiviral particles in the process that required a significant and non-routine experimentation. Furthermore, neither Porter *et al.*, nor Uchida *et al.* disclose or suggest that the vector particles should be substantially free of factors that induce stem cell differentiation by being substantially free of producer cells and producer cell supernatant. Moreover, as specified above, Porter *et al.* teach away from the present invention and from the method of concentrating viral stocks using ultracentrifugation described in Uchida *et al.* article by disclosing, *e.g.*, at page 915 (left column, ¶3 and right column, ¶ 2) and page 917 (Table 3), that, to maximize the efficiency of infection, the transduction of pseudotyped vectors into bone marrow cells was performed by co-cultivation with virus-producing cells.

In summary, neither Porter *et al.* nor Uchida *et al.* provide a suggestion to be combined with the other reference, and, even if taken together, do not disclose or suggest the transduction method and the resulting transduced stem cells as recited in the present claims.

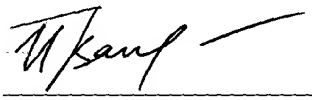
In light of the foregoing arguments, it is respectfully submitted that pending claims are not obvious over the cited art. Reconsideration and withdrawal of the obviousness

rejection is believed to be in order.

CONCLUSION

Applicants request entry of the foregoing amendments and remarks in the file history of this application. In view of the above amendments and remarks, it is respectfully submitted that claims 2-37 are now in condition for allowance and such action is earnestly solicited. If the Examiner believes that a telephone conversation would help advance the prosecution in this case, the Examiner is respectfully requested to call the undersigned agent at (212) 527-7634. The Examiner is hereby authorized to charge any additional fees associated with this response to our Deposit Account No. 04-0100.

Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Patrick F. Kelly; Elio F. Vanin

Serial No.: 09/801,302 Art Unit: 1636

Confirmation No.: 2679

Filed: March 7, 2001 Examiner: Celine X. Qian

For: HIGHLY EFFICIENT GENE TRANSFER INTO HUMAN REPOPULATION STEM CELLS BY RD114 PSEUDOTYPED RETROVIRAL VECTOR PARTICLES

MARK-UP FOR AMENDMENT AND RESPONSE TO THE OFFICE ACTION OF FEBRUARY 13, 2002

Hon. Commissioner of
Patents and Trademarks
Washington, DC 20231

May 20, 2002

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Name (Print) Signature

CLAIMS:

2. (Amended) The method of claim [1] 3, wherein the vector particle is a retroviral vector particle comprising a modified retroviral genome containing the gene of interest.

3. (Amended) A [highly efficient] method for transducing stem cells with a [retroviral] vector particle containing a gene of interest, which method comprises contacting target stem cells with [retroviral] vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest, wherein the vector particles are substantially free [The method of claim 2, wherein the retroviral vector particles are freed] of factors that induce stem cell differentiation by being substantially free of producer cells and producer cell supernatant, and whereby the transduced stem cells are capable of expressing the gene of interest.

4. (Amended) The method of claim [3] 2, wherein the retroviral particles are pre-adsorbed onto a surface that promotes adherence of the retroviral particles.

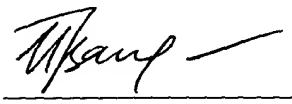
10. (Amended) The method of claim [1] 3 wherein the target stem cells are pre-stimulated.

12. (Amended) The method of claim [1] 3 wherein the target stem cells are hematopoietic stem cells.

17. (Amended) A population of stem cells transduced with vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest, wherein the [population of stem cells are substantially undifferentiated] vector particles are substantially free of producer cells and producer cell supernatant and whereby the transduced stem

cells are capable of expressing the gene of interest.

Respectfully submitted,



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APPENDIX

PENDING CLAIMS: May 20, 2002
(Application Serial No.: 09/801,302 Filed: March 7, 2001)

2. (Amended) The method of claim 3, wherein the vector particle is a retroviral vector particle comprising a modified retroviral genome containing the gene of interest.

3. (Amended) A method for transducing stem cells with a vector particle containing a gene of interest, which method comprises contacting target stem cells with vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest, wherein the vector particles are substantially free of factors that induce stem cell differentiation by being substantially free of producer cells and producer cell supernatant, and whereby the transduced stem cells are capable of expressing the gene of interest.

4. (Amended) The method of claim 2, wherein the retroviral particles are pre-adsorbed onto a surface that promotes adherence of the retroviral particles.

5. The method of claim 4, wherein the surface is coated with an adherence promoting agent.

6. The method of claim 5, wherein the adherence promoting agent is retronectin.

7. The method of claim 2, wherein the retroviral particles are freed of producer cells and producer cell supernatant by ultracentrifugation.

8. The method of claim 2, wherein the retroviral particle is an oncoviral particle.

9. The method of claim 2 wherein the retroviral particle is a lentiviral particle.

10. The method of claim 3 wherein the target stem cells are pre-stimulated.

11. The method of claim 10, wherein the target stem cells are prestimulated by treatment with signaling molecules selected from the group consisting of cytokines, growth factors and phytohemagglutinin.

12. (Amended) The method of claim 3 wherein the target stem cells are hematopoietic stem cells.

13. The method of claim 12 wherein the target hematopoietic stem cells are selected from the group consisting of cord blood cells, mobilized peripheral blood cells, bone marrow cells, and liver.

14. The method of claim 13, wherein the target hematopoietic stem cells are selected from the group consisting of CD34+ cells and CD34+ CD38- cells.

15. The method according to claim 2, wherein upon engraftment of the transduced stem cells contacted one time with the retroviral particles into a host, greater than 10% of the transduced cells express the gene of interest.

16. The method according to claim 15, wherein greater than about 40% of the transduced cells express the gene of interest.

17. (Amended) A population of stem cells transduced with vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest, wherein the vector particles are substantially free of producer cells and producer cell supernatant and whereby the transduced stem cells are capable of expressing the gene of interest.

18. The population of stem cells of claim 17, wherein the vector particle is a retroviral particle comprising a modified retroviral genome containing the gene of interest.

19. The population of stem cells of claim 18, wherein upon engraftment of the stem cells into a host, the number of stem cells in the host that express the gene of interest is greater than 10% times a number of exposures of the stem cells to the retroviral vector particles.

20. The population of stem cells of claim 18, wherein the stem cells were transduced by a single exposure to the retroviral vector particles and upon engraftment of the stem cells into a host, greater than about 40% of the stem cells express the gene of interest.

21. A method for introducing a gene of interest into a host, which method comprises introducing the transduced stem cells of claim 17 into a host.

22. The method according to claim 21, wherein the host is a human and the stem cells are human stem cells.

23. The method according to claim 21, wherein the host is an immunodeficient animal and the stem cells are human stem cells.

24. The method according to claim 21, wherein upon engraftment of the transduced stem cells contacted one time with the retroviral particles into a host, greater than 10% of the transduced cells express the gene of interest.

25. The method according to claim 24, wherein greater than about 40% of the transduced stem cells express the gene of interest.

26. A method of treating a disease or disorder, which method comprises administering to a patient a therapeutically effective dose of the transduced stem cells of claim 17, wherein the gene of interest is a therapeutic gene.

27. The method of claim 26, wherein the disease or disorder is selected from the group consisting of hematopoietic disease, neural disease, joint-related disease, muscular disease, and liver disease.

28. A non-human animal engrafted with the stem cells of claim 17.

29. The non-human animal of claim 28, which is an immunodeficient mouse.

30. The non-human animal of claim 28, which is a monkey.

31. A kit comprising retroviral vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest their genome pre-adsorbed onto a surface that promotes adherence of the retroviral particles, wherein the retroviral vector particles are substantially free of producer cells and producer cell supernatant.

32. The kit of claim 31, wherein the surface is coated with an adherence promoting agent.

33. The kit of claim 32, wherein the adherence promoting agent is retronectin.

34. A method for preparing a kit comprising retroviral vector particles pseudotyped with feline endogenous virus RD114 envelope protein and containing a gene of interest their genome pre-adsorbed onto a surface that promotes adherence of the retroviral particles, wherein the retroviral vector particles are substantially free of producer cells and producer cell supernatant, which method comprises contacting the surface with the retroviral vector particles for a sufficient period of time to permit adherence of the retroviral particles to the surface, and removing supernatant in which the retroviral particles were suspended from the surface.

35. The method of claim 34, wherein the surface is coated with an adherence promoting agent.

36. The method of claim 35, wherein the adherence promoting agent is retronectin.

37. The method of claim 34, further comprising storing the retroviral particles adsorbed onto the surface at -70 C.